CLAIMS

1. An apparatus for providing active clearance control between blade tips and seals in a turbomachine comprising:

a first stator carrier segment, with stator seals centripetally disposed thereon;

a second stator carrier segment located along a same circumference as the first stator carrier segment, and with stator seals centripetally disposed thereon;

a shell that adjustably houses the first stator carrier segment and the second carrier segment;

at least one displacement apparatus in operable communication with at least one stator carrier segment, of the first and second carrier segments, and configured to position the at least one stator carrier segment to provide active clearance control to the stator seals disposed thereon.

2. The apparatus of claim 1 wherein the at least one displacement apparatus is further configured:

to be in operable communication with the first stator carrier segment and the second carrier segment; and

to move the first stator carrier segment and second carrier segment radially away from each other.

3. The apparatus of claim 1, further comprising:

at least one axial displacement apparatus in operable communication with at least one stator carrier segment and the shell; and

the at least one axial displacement apparatus is configured to axially position the at least one stator carrier segment with respect to the shell.

4. The apparatus of claim 1, wherein the displacement apparatus is selected from the group consisting of springs, bellows, inflatable tubes, rods, cams, hydraulic cylinders, piezoelectric devices, wires, cables, bi-metallic materials, phase changing materials, solenoids, and pneumatic bellows actuators.

5. The apparatus of claim 1, wherein:

the first segment is split along a first splitline, and forms a first quad-segment and a second quad-segment;

the second segment is split along a second splitline, and forms a third quad-segment and a fourth quad-segment.

6. The apparatus of claim 5 further comprising:

at least one displacement apparatus in operable communication with the first quad-segment and with the second quad-segment, and is configured to move the first quad-segment and the second quad-segment radially away from each other; and

at least one displacement apparatus, in operable communication with the third quad-segment and with the fourth quad-segment, and is configured to move the third quad-segment and the fourth quad-segment radially away from each other.

7. The apparatus of claim 1 further comprising:

radial position sensors configured to monitor the radial position of the stator seals.

8. The apparatus of claim 7 further comprising:

a control system configured to use signals from the radial position sensors to provide feedback for active clearance control to the stator seals.

9. The apparatus of claim 5, wherein the first splitline and the second splitline are perpendicular to each other.

10. A turbomachine with active clearance control comprising:

a centrally disposed rotor;

at least one row of rotating blades extending radially from the rotor, and each of the rotating blades having a rotor blade tip;

a shell enclosing the rotor and rotating blades;

at least one stator carrier split along a splitline into a first segment and a second segment, with at least one row of stator blades extending centripetally from the first segment and from the second segment, the at least one stator carrier adjustably housed within the shell and each of the stator blades having a stator blade tip, and with stator seals centripetally disposed on the first segment and second segment; and

at least one displacement apparatus in operable communication with the first segment and the second segment, and the at least one displacement apparatus is configured to move the first segment and second segment radially away from each other thereby providing active clearance control to the rotor blade tips and the stator blade tips.

11. The turbomachine of claim 10, further comprising:

a plurality of axial actuators operatively coupled to the stator carrier and to the shell; and

wherein the plurality of axial actuators are configured to move the stator carrier axially with respect to the shell.

12. The turbomachine of claim 10, wherein:

the first segment is split along a first splitline, and forms a first quad-segment and a second quad-segment;

the second segment is split along a second splitline, and forms a third quad-segment and a fourth quad-segment; and

the turbomachine further comprises:

at least one displacement apparatus in operable communication to the first quad-segment and to second quad-segment, and is configured to move the first quad-segment and the second quad-segment radially away from each other; and

at least one displacement apparatus in operable communication to third quad-segment and to the fourth quad-segment, and is configured to move the third quad-segment and the fourth quad-segment radially away from each other.

13. The turbomachine of claim 10, wherein the displacement apparatus is selected from the group consisting of springs, bellows, inflatable tubes, rods, cams, hydraulic cylinders, piezoelectric devices, wires, cables, bi-metallic materials, phase changing materials, solenoids, and pneumatic bellows actuators.

14. The turbomachine of claim 10 further comprising:

radial position sensors configured to monitor the radial position of the stator seals relative to the rotor.

15. The turbomachine of claim 14 further comprising:

a control system configured to use signals from the radial position sensors to provide feedback for active clearance control to the rotor blade tips.

16. The turbomachine of claim 15 further wherein the control system is further configured to provide discrete active clearance control to the radial blade tips and stator blade tips.

17. The turbomachine of claim 14, wherein the radial position sensors are selected from the group consisting of eddy-current probes, photoelectric sensors and magnetic sensors.

18. A control system for providing active clearance control to a turbomachine comprising:

a stator carrier split along a splitline into a first segment and a second segment, with at least one row of stator blades extending centripetally from the first segment and from the second segment, and stator seals centripetally disposed on the stator carrier;

a shell that adjustably houses the stator carrier and stator blades; and

at least one displacement apparatus in operable communication with the first segment and the second segment, and the at least one displacement apparatus is configured to move the first segment and second segment radially away from each other.

19. The control system of claim 18 further comprising:

radial position sensors configured to monitor the radial position of stator seals.

20. The control system of claim 19 configured to use signals from the radial position sensors to provide feedback for active clearance control for stator seals.

21. The control system of claim 20 further configured to provide discrete active clearance control to the stator seals.

22. A method of active clearance control for a turbomachine comprising:

determining when a possible rub generating condition will occur;

radially separating a stator carrier first segment and a stator carrier second segment prior to the possible rub generating condition; and

restoring the stator carrier first segment and stator carrier second segment to their original positions after the possible rub generating condition has occurred.

23. A method of active clearance control for a turbomachine comprising:

determining when a possible rub generating condition will occur;

axially moving a stator carrier first segment and a stator carrier second segment to a position where there are lower centripetal forces acting on the stator carrier segments;

radially moving apart the stator carrier first segment and the stator carrier second segment prior to the possible rub generating condition; and

restoring the stator carrier first segment and stator carrier second segment to their original positions after the possible rub generating condition has occurred.

24. A turbomachine with active clearance control comprising:

means for increasing blade tip clearances; and

means for restoring blade tip clearances.

25. The turbomachine of claim 24 further comprising a means for decreasing centripetal pressure forces acting on stator carriers.